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THE

# Journal of the Society of Arts,

AND OF

# THE INSTITUTIONS IN UNION.

110th Session.] FRIDAY, JANUARY 22, 1864. [No. 583. Vol. XII.

## Announcements by the Council.

### The Swiney Bequest.

A meeting of the judges appointed under the will of the late Dr. Swiney to award, in concert with the Royal College of Physicians, on every fifth anniversary of Dr. Swiney's death, "a silver goblet of the value of £100, with gold coin in it to the same amount," took place on Wednesday, the 20th January, at the Society's House. The award was made in favour of Henry Sumner Maine, Esq., D.C.L., late Regius Professor of Civil Law in the University of Cambridge, and now Member of the Legislative Council of India, for his work on jurisprudence entitled, "Ancient Law." The cup has been executed by the Messrs. Garrards, from a design, made expressly for the Society, by Daniel Maclise, Esq., R.A.

### Ordinary Meetings.

Wednesday Evenings, at 8 o'clock.

Jan. 27.—"On the Metric System of Weights and Measures, and its Proposed Adoption in this Country." By Samuel Brown, Esq., F.I.A., F.S.S.

Feb. 3.—"On Instantaneous Engraving upon Metal." By Mons. E. Vial (illustrated with experiments).

Feb. 10.—"On Fresco Painting, as a suitable mode of Mural Decoration." By J. Beavington Atkinson, Esq.

### Cantor Lectures.

Courses of Lectures on the following subjects will be delivered during the Session:—

The Operation of the Present Laws of Naval Warfare on International Commerce. By G. W. Hastings, Esq., Barrister-at-Law.

Fine Arts Applied to Industry. By W. Burges, Esq.

Chemistry Applied to the Arts. By Dr. F. Crace Calvert, F.R.S.

The third and fourth lectures of Mr. Hastings' course will be delivered on Mondays, the 25th January and 1st February, at 8 o'clock; the subjects will be as follows:—

Contraband; its Nature and Usages.

Capture of Private Property at Sea; present State of the Law as modified by the Declaration of Paris; Arguments for and against its Continuance.

The Foreign Enlistment Act; its Operation on Commerce.

### Institutions.

The following Institution has been taken into Union since the last announcement:—

Hyde (near Manchester) Mechanics' Institution.

The Christmas subscriptions are now due, and should be forwarded by cheque or post-office order, made payable to the Financial Officer, Samuel Thomas Davenport. All cheques and post-office orders should be crossed through Messrs. Coutts and Co.

## Proceedings of the Society.

### Sixth Ordinary Meeting.

Wednesday, January 20th, 1863; William Hawes, Esq., Chairman of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Appleby, T. H., 30, Gracechurch-street, E.C.
Ashton, Thomas, J.P., Portland-street, Manchester.
Bartley, George C. T., South Kensington Museum, S.W.
Beauclerc, Capt. George, 23a, Grosvenor-street West, W.
Bickford, J. J., Tuckingmill, Cornwall.
Butler, James Robert, 4, Elm-street, Gray's-inn-road, W.C.
Cargill, William Walter, M.P., 4, Connaught-place West, W.
Cole, Alan Summerly, South Kensington Museum, S.W.
Cole, Lieut. Henry Hardy, R.E., Brompton Barracks, Chatham.
Corbould, Edward Henry, 10, Hyde-park-gate South, W.
Cross, William S., Park-street, Richmond, S.W.
Davies, John, 166, Queen-street, Portsea.
Del Rio, Patricio M., 130, Jermyn-street, St. James's, S.W.
Edwards, Rev. Allen T., M.A., 5, Kennington-terrace, S.
Fisher, George, The Woodlands, near Cardiff.
FitzGerald, Lord Otho, 8, Carlton-house-terrace, S.W.
Howell, George, 693, Old Kent-road, S.E.
Lawrence, Hugh M., Atlas Works, Manchester.
Lloyd, James Richard, Shrubbery, Belmont-hill, Lee, S.E.
Mackinlay, D., 42, Clarges-street, Piccadilly, W.
Martin, Louis Emile Constant, Chateau Boujeon, Rue Balzac, Paris; and 32, Albany-street, Regent's-park, N.W.
Masters, M., 1, Paragon-place, New Kent-road, S.E.
Moser, John, 165, High-street, Southwark, S.
Owen, Philip Cunliffe, South Kensington Museum, S.W.
Oxland, Robert, F.C.S., Empire City, Nevada Territory, America.
Rodgers, Rev. John, 17, Mecklenburgh-square, W.C.
Sale, Colonel Thomas Henry, 27, Westbourne-park, W.
Sturgeon, John, Pease's-buildings, Leeds.

Thicke, Charles James, 17 and 18, New Bridge-street, Blackfriars, E.C., and Rosendale, Dulwich, S.E.
Walker, Mowbray, Millwall Iron Works, E.
Wolff, Lewis, 15, Albert-square, Clapham, S.

The following candidates were balloted for and duly elected members of the Society :—

Attwood, Matthias Wolverley, F.R.G.S., Dulwich S.
Bowyer, Rev. W. N. Wentworth A., Rectory, Clapham-common, S.
Brown, Henry, Ettrick Mills, Selkirk, N.B.
Cotton, Charles P., 11, Lower Pembroke-street, Dublin.
Cutler, Joseph, 4, Pollington-villas, Holloway-road, N.
Ellis, Wynn, 30, Cadogan-place, S.W.; Ponsbourne-park. Hertford; and Tankerton, near Canterbury.
Forbes, H., 6, Aberdeen place, Maida-hill, W.
Hanson, Reginald, 43, Upper Harley-street, W.
Hardwicke, Robert, 192, Piccadilly, W.
Johnson, William, 188, Tottenham-court-road, W.
Kiessler, T., 18, Spencer-street, Goswell-road, E.C.
Lumley, Henry, 4, Guildford-place, Russell-square, W.C.
Maynard, Henry, Oakfield-lodge, Hawkhurst Kent.
Mercer, Thomas, 45, Spencer-street, Goswell-road, E.C.
Needham, John, Albert Iron Works, Warrington.
Nicholson, W. W., 17, King-street, Cheapside, E.C.
Shand, James, Upper Ground-street, Blackfriars, S.
Southorn, Edwin, Broseley, Salop.

The Paper read was—

## ON THE INJURIOUS EFFECTS OF SMOKE ON CERTAIN BUILDING STONES AND ON VEGETATION.

BY DR. AUGUSTUS VOELCKER, CONSULTING CHEMIST TO THE ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

The subject on which it is my privilege to address my audience to-night is, it will be conceded by all present, of great practical importance. This must be the plea for my venturing to speak on a matter which has been discussed with great ability in this room on a former occasion. Not having any intrinsically valuable discovery of my own to bring forward, nor to communicate a plan more effectual than any of the numerous devices which have been recommended for preventing the decay in building stones, I have to crave your kind indulgence in appearing before you to-night. I trust, however, my observations and the experiments on which they are based will not be altogether void of interest, and may lead to a useful discussion on the part of others, so much better qualified than myself to speak on the subject.

Much has been said and written on the causes of the rapid decay to which some building stones are liable. Chemists, mineralogists, architects, builders, and other scientific and practical men have on various occasions devoted a good deal of time and painstaking labour to investigations, purporting to trace the beginning and progress of this decay, and to discover, if possible, the means of preventing the injury which calcareous building stones sustain under the influence of the atmosphere. Their labour has not been altogether unsuccessful, and several suggestions, of more less value, have been made, which are well calculated to mitigate, if not to prevent, the evil. Still our information on the true character of the decay in particular stones is but scanty, nor are the means of preventing decay in buildings so perfect as not to call for further improvements.

Every addition to our knowledge of the causes of decay in stones has a tendency to bring within easier reach the appropriate remedy. At all events, a more comprehensive knowledge on this subject in stones will help us to discriminate with more certainty between good and bad stones, and to avoid the employment of building materials which, although they stand the influence of the weather very well in the open country, are nevertheless unfit for particular parts of a building, and cannot be used with safety in some localities. Having been engaged for some time past in examining the characteristic black crusts which are frequently seen on buildings erected of Bath and similar oolitic limestones, my attention was specially directed to the study of the nature of the decay which attacks with great energy some kinds of calcareous stones, and I have come to the conclusion that the injury which the smoke of towns exerts on Bath stone, magnesian limestone, and other calcareous building stones, is far more pernicious in its results than it is generally believed to be. It will, therefore, devolve upon me to direct your attention particularly to the changes which such stones undergo under the influence of a smoky atmosphere, such as we find in most towns.

In every day life we usually understand by smoke, the black and more or less tangible impure air which rises from the chimneys of fire-places and furnaces in which the combustion of the fuel is imperfect, in consequence of which some finely-divided carbon and a variety of gases are thrown into the air.

That this black smoke exerts an injurious influence on building stones and on vegetation, is admitted in a general way, but I have no hesitation in saying that the extent of the injury done by the smoke that at times obscures the sky in our crowded cities has not been fully recognised. This, perhaps, is the reason why the precise chemical changes produced by accumulations of soot on limestones and calcareous sandstones have not been studied with sufficient minuteness.

Before giving an account of my analytical experiments on the effect of smoke on oolitic limestones, a few general observations on the nature of the decay in stones may not be out of place.

Building stones in general may be divided into two classes:—

1. Stones which, like granite, porphyries, and most sandstones, are not easily acted upon by acids.
2. Stones which, like limestones, dolomites, and some kinds of calcareous sandstones, are composed of materials that are partially or entirely attacked by acids with facility.

Building stones belonging to the second class are much more liable to suffer injury by atmospheric agencies than those belonging to the first class; and as, moreover, limestones and dolomites are principally employed for ornamental buildings, the investigation of the causes which lead to their decay possesses a special interest.

The conditions under which calcareous stones decay when placed in a building, are partly mechanical and partly chemical. The absorption of moisture by porous stones, and the disintegration to which it leads in consequence of the resistless expanding force of water in becoming ice in cold weather, are illustrations of a purely mechanical cause and effect, which frequently manifest themselves in limestones used for building purposes. The changes produced on building stones by carbonic acid and the sulphur compounds in the air of towns, are instances of chemical reactions, which may be seen in their results in some cases as distinctly as the results of purely mechanical force, to which allusion has just been made. Building stones of a loose or irregular structural composition are of course more liable to suffer injury from the absorption of moisture than hard, compact, and crystalline stones of the same or similar composition. The more readily a specimen of Bath or Caen stone is affected by mechanical agencies the more easily it will be found to be acted upon by chemical reagents. It will not, therefore, be necessary, nor indeed desirable, to examine separately the mechanical and the chemical conditions of decay. I would, therefore, notice together the physical and the chemical effects likely to be produced in calcareous building stones by the different constituents of the atmosphere.

Of the normal component parts of air, oxygen, moisture, carbonic and nitric acid have to be regarded as probable agents of destruction. The abnormal or accidental constituents of the air of towns are certain sulphur acids, soot, and occasionally hydrochloric acid. These accidental impurities require particular examination, as they are really more pernicious in their effects upon building stones, as well as on vegetation, than the normal constituents, which, it need hardly be observed, exert no injurious influence upon vegetation.

The action of oxygen is of comparatively a subordinate character, its effects being confined to constituents usually absent or occurring only exceptionally, and in but small quantities in limestones and dolomites. In calcareous sandstones sulphides of iron and protoxides of iron and manganese are occasionally found, and as these compounds are very prone to absorb oxygen, and the higher oxides thus formed are more voluminous than the original protoxides, such stones are subject to the disintegrating action of atmospheric oxygen. Of far greater importance are the effects of moisture. Water, either in the shape of vapour or liquid, perhaps is the most powerful agent of destruction that displays itself in the gradual crumbling down of calcareous stones. Porous and soft stones of that kind should never be employed for parapets, window-sills, weather beds of cornices, strings, plinths, or other parts of a building where water may lodge. The changes which water produces in porous stones exposed to drip and alternations of a wet and dry condition appear to be less of a chemical than a mechanical character.

Water is subject to expansion on sudden alterations in the surrounding atmosphere, and the irresistible force it then exerts, necessarily exercises a disintegrating action. If the temperature sinks below the freezing point, this destructive action is most powerful, since water in becoming ice suddenly and greatly expands. But even above the freezing point, the expansion of water at a sudden elevation of temperature appears to me to exert, upon porous building materials, a mechanical force sufficiently powerful to account for their gradual decay, at seasons of the year when it cannot be referred to the formation of ice within the pores of the stone. There can be no doubt that all stones which possess in a high degree the property of absorbing moisture, are unfit for building purposes. Certain kinds of porous limestones and sandstones, differing widely in composition and in relation to their liability to become attacked by acids, are alike subject to this disintegrating action, thus indicating plainly that their decay is not the result of the chemical action of an atmospheric constituent, but the result of the mechanical action which water exerts on all porous and absorbent materials, no matter what their composition may be.

Such stones, it will be readily conceived, must be very liable to crumble down in our moist and changeable climate. In towns, and in the country in sheltered or in exposed parts, on the outside or the inside of buildings, and in short under the most varied conditions, the decay will proceed steadily when it has once begun to show itself in porous and absorbent stones. The fact that these building stones decay as readily in open country places as in towns, has led some men to entertain the opinion that the impurities present in the air of towns and in the immediate neighbourhood of manufacturing districts, have nothing to do with the gradual disintegration to which oolitic and other calcareous building stones are subject. But although it is quite true that some building stones do not require to be exposed to the injurious effects of the atmospheric impurities of crowded cities in order to decay, it is no less certain that there are others which stand wind and weather well in the country, but are more or less readily attacked by atmospheric influences when employed in the erection of town residences.

The fact is, the structural composition of some stones is so irregular, and radically bad, and their absorbent powers of moisture so great, that they are alike unfit for the erection of buildings in town or country, whilst there are others possessing sufficiently good physical characters to resist the mechanical effects of water, to which reference has been made, and remaining sound in a comparatively speaking pure air, but which are not of such a chemical composition as to be capable of withstanding the pernicious chemical influence of a less pure town atmosphere.

Carbonic acid is a never-failing constituent of the air, and consequently is present also in rain-water. Much stress has been laid on the dissolving action of rain-water, but it appears to me this action has been greatly overrated. Instead of practical proofs, showing that water charged with carbonic acid really exerts a powerful disintegrating influence upon calcareous stones, merely theoretical reasonings have been advanced in support of that opinion.

It is true, water charged with carbonic acid in contact with carbonate of lime or magnesia gives rise to soluble bicarbonates, but even were the quantity of bicarbonate of lime or magnesia much greater than it actually is, the mere removal of a trifling portion of lime from the surface of the stone, does not, I take it, explain the peculiar exfoliation and corroded appearance which many oolitic building stones present to our view. Calcareous stones, exposed to the long-continued dissolving action of water containing carbonic acid, exhibit rather a smooth and not a corroded appearance.

In the next place we have to consider the effects likely to be produced by the small quantities of nitric acid which are invariably present in the atmosphere. The proportion of nitric acid in the air is so minute that it may be questioned whether these minute traces have any marked influence on our buildings. With respect to the supposed corrosive action of the nitric acid of the air, and the formation of nitrates in limestones, I made some experiments, a brief account of which may here find a place. A few years ago my attention was directed to the decay of the oolite limestone of which the lodge at one of the entrances at Badminton is built. This stone was quarried at a place about two miles from Badminton, and, like all Bath stone, is not very hard. The stone protected by the porch of the lodge I found in a more advanced state of decay than that freely exposed to wind and weather. Blocks from under the porch and the exposed part of the lodge were obtained and examined by me for nitrates. Of each block a portion of the exterior side in contact with the air, and the interior side touching the remainder of the thick walls of the lodge were examined separately, and the following results were obtained, by adopting Dr. Pugh's accurate method for determining minute quantities of nitric acid:—

No. 1. Stone from under the porch of the lodge—

| | Per centage of nitric acid. | Mean. |
|---|---|---|
| a. Interior side ........................ | ·1786 | ·2256 |
| b. Exterior side ........................ | ·2726 | |

No. 2. Stone unprotected by the porch—

| | Per centage of nitric acid. | Mean. |
|---|---|---|
| a. Interior side of the stone ......... | ·1269 | ·1480 |
| b. Exterior side exposed to the air.. | ·1692 | |

It will be seen that both blocks contained small quantities of nitric acid, which probably is a never-failing constituent of calcareous stones. It will also be observed that the stone protected by the porch contained rather more nitric acid than that freely exposed to the weather, and likewise that the external side of both blocks contained somewhat more nitric acid than the interior sides. These results agree well with what may be expected to take place under the different conditions in which the several portions of the stone were found. The sides in contact with the air might naturally be expected to contain more nitric acid than the inside not so thoroughly penetrated by the air, and the circumstance that less nitric acid was found in the stone not protected by the porch, is probably explained by the removal of some of the soluble nitrates by the rain striking against the exposed surface. It has been stated already that the protected stone was more affected by decay than that not protected by the porch of the lodge. Thinking it just possible that the two blocks might differ in composition, I analysed a portion of each, and obtained the following results:—

| | No. 1. Limestone under porch. | No. 2. Limestone unprotected. |
|---|---|---|
| Moisture | 1·46 | ·81 |
| Oxides of iron and alumina | ·98 | 1·81 |
| Phosphoric acid | ·14 | ·18 |
| Carbonate of lime | 93·91 | 94·64 |
| Sulphate of lime | 1·34 | 1·24 |
| (Containing sulphuric acid) | (·79) | (·72) |
| Magnesia | ·73 | ·77 |
| Nitric acid | ·225 | ·148 |
| (Mean of the two determinations.) | | |
| Insoluble siliceous matter | ·97 | ·95 |
| | 99·755 | 100·548 |

The differences in the chemical compositions of the two stones are too trifling to account for the greater injury which that protected by the porch had sustained; nor do I think it at all likely that the small quantities of nitric acid which were found had anything to do with the decay of the stone. For confirmation of this the following result may be mentioned:—One of the stones was kept as a specimen in a damp room for rather longer than a year, during which period a considerable portion crumbled down to a coarse powder. In the expectation of finding the process of nitrification to have caused the disintegration of the stone, I made a careful nitric acid determination in this powder, and was disappointed in not obtaining more than ·192 per cent of this constituent, showing that the proportion of this acid had not sensibly increased, and that the crumbling down of the stone was not connected with an increased nitrification, but more probably the result of the dampness of the room in which the specimen was preserved. Here then we have an example of a limestone crumbling down by degrees solely under the influence of damp. There was no deposition of soot on the stone, and no chemical action of any of the constituents of air, except moisture, could be observed to have taken place.

In the next place the foreign or accidental impurities of the air of towns will have to be considered.

The quantity of sulphur-acids in the air of towns is quite appreciable. The quantity of coals consumed in London for domestic and manufacturing purposes exceeds three million tons per annum, and as all coals contain sulphur, the greater portion of which is discharged during their combustion as sulphurous and other sulphur-acids, an enormous quantity of these destructive acids must find their way into the air. No numerical data exist with regard to the proportion of sulphur-acids in the London atmosphere, but, according to Dr. Angus Smith, the air of Manchester contains an average proportion corresponding to one part of sulphuric acid in every 100,000 parts of air, which, in the centre of the town, rises to 25 parts in 100,000. According to the quality of the coal and the amount consumed in a given space in a given locality the proportion of sulphur-acids in the air of towns will vary. In some places it may, no doubt, be greater, in others less than in the air of Manchester, but under all circumstances it will be sufficiently large to cause serious apprehensions.

The strong affinity of sulphuric acid for lime and magnesia render it a destructive agent for calcareous building stones. Sulphuric acid not only renders soluble these earthy carbonates, but, forming with lime gypsum, a compound which contains in round numbers 20 per cent. of water of crystallization, and with magnesia the well-known sulphate of magnesia, a salt remarkable for the large proportion of water of crystallisation which it fixes, it gives rise to a mechanical destruction of Bath stone and magnesian limestones similar in every respect to that produced by freezing water. The efflorescences of sulphate of magnesia which have been noticed upon those portions of magnesian limestones where exfoliation has taken place, afford a practical proof of the destructive action of the sulphuric acid that occurs in the air of towns. Hydrochloric acid occasionally has been found in the air of towns. It is, however, not a usual impurity; and as on the 1st of January the act passed in the late session for the more effectual condensation of muriatic acid gas in chemical works came into actual operation, and there is no practical difficulty in securing the condensation of this gas, no fear need be entertained that the buildings in towns will be affected by hydrochloric acid fumes.

Still more pernicious in its influence than the free sulphur-acids which exist in the air of towns, I have reason to believe is the black smoke which deposits soot, to the great disfigurement of our public and private buildings. The soot deposit is particularly destructive to the carved portions of buildings. In order to render intelligible the peculiar chemical action which smoke exerts on calcareous building stones, I beg to invite attention to the following analysis of a sample of ordinary house-coal soot, which I made many years ago. In 100 parts of soot I found:—

| | |
|---|---|
| Moisture | 10·620 |
| Organic matter (chiefly black carbon) | 44·736 |
| Chloride of ammonium | ·933 |
| Sulphate of ammonia | 3·580 |
| Chloride of sodium | ·231 |
| Chloride of potassium | ·503 |
| Oxides of iron and alumina | 15·691 |
| Sulphate of lime | 11·051 |
| Phosphate of lime | ·530 |
| Carbonate of lime | 1·129 |
| Lime in a state of silicate | 2·290 |
| Magnesia in a state of silicate | ·389 |
| Soluble silica | 4·014 |
| Insoluble siliceous matters | 4·159 |
| | 99·856 |

The per centage of sulphate of ammonia in different samples of soot I find varies exceedingly. In some samples I have found as much as ten, twelve, and even more of sulphate of ammonia. Perhaps 5 or 6 per cent. represents better the average quantity of ammonia than the figures in the above analysis. Soot is essentially a mechanical mixture of finely-divided carbon with sulphate of ammonia, some sal ammoniac, and fine particles of coal-ashes. Soot, it need hardly be remarked, is a constituent of the smoky atmosphere of towns, and is calculated to do great injury to the ornamental work of buildings executed in Bath stone or magnesian limestone. The most destructive agent of such a smoky atmosphere, as far as calcareous building stones are concerned, I am inclined to think is the sulphate of ammonia, which, as has been shown, is a constant constituent of soot. This conclusion has been forced upon me by the examination of the sooty deposit found on a magnificent church in a large commercial and manufacturing town. This church is built of an oolitic limestone found in the neighbourhood, and on account of the increasing decay, which has quite disfigured the structure, and in many places effaced the finer delineations of the carved work, is now under the process of restoration. On some of the older parts of the church the corrosive agents of a smoky atmosphere appear to have penetrated the stone to a considerable depth. The stone here appears to be covered with black crusts, varying in thickness from half an inch to more than an inch and a half. These crusts crumble off spontaneously from time to time, or can be easily removed by the application of a slight pressure. I have placed upon the table specimens of crusts similar to those which I made the subject of a rigorous analysis, with a view of ascertaining the changes the original building stone evidently had undergone under the influence of a smoky atmosphere, and I was perfectly amazed to find how radically the original composition of the stone had become changed, and was left in no doubt as to the origin of the black crusts.

The church on which these crusts occur is built with a good limestone, composed chiefly of carbonate of lime, with no more sulplate of lime, magnesia, oxide of iron, and insoluble siliceous matters than generally occur in the better descriptions of oolitic limestones, as will be seen by the following analysis:—

| | |
|---|---|
| Water driven off at 212° | ·230 |
| Water of combination | ·110 |
| Carbonate of lime | 97·690 |
| Sulphate of lime | ·153 |
| Magnesia | ·470 |
| Protoxide of iron | ·540 |
| Alumina | ·120 |
| Soda | ·044 |
| Potash | ·296 |
| Insoluble siliceous matter (silica) | 1·350 |
| | 101·003 |

In the course of years this stone becomes covered, as has been already stated, with a dark-coloured incrustation, which increases in depth from year to year. These black crusts are soluble to a large extent in water; in some specimens I found as much as two-thirds soluble in water and only one-third insoluble. Dried at 212° they yielded the following results:—

| | | |
|---|---|---|
| *Portion soluble in water* | 65·94 | |
| Sulphate of lime | | 51·23 |
| Sulphate of magnesia | | 1·61 |
| Chloride of sodium | | ·47 |
| Water of combination | | 12·63 |
| *Portion insoluble in water* | 34·06 | |
| Organic matter (black carbon) | | 5·72 |
| Oxides of iron of alumina | | 2·57 |
| Carbonate of magnesia | | ·10 |
| Carbonate of lime | | 19·03 |
| Insoluble siliceous matter | | 6·64 |
| | | 100·00 |

A comparison of the composition of the crusts with that of the stone upon which they were found deposited, suggests the following remarks:—

1. The greater part of the carbonate of lime, which is the chief constituent of the stone, has become changed into sulphate of lime. Sulphate of lime and water of combination are given separately in the preceding analysis, both having been obtained by direct and separate determinations. Uniting the two together we have no less than 63·86 per cent. of hydrated sulphate of lime; and only 19 per cent. of carbonate of lime escaped transformation into sulphate.

2. Nearly the whole of the magnesia in the crusts is present as sulphate of magnesia, whilst it occurs in the stone as carbonate.

3. The crusts contained in round numbers 5¾ per cent. of black carbon, showing that a large proportion of soot must have come into actual contact with the surface of the stone.

4. Both the amount of oxides of iron and insoluble siliceous matters in the black deposit is very much greater than in the original stone. An examination of the insoluble siliceous matter has shown that it is of the same nature as the siliceous matter of coal-ashes. The fine particles of coal-ashes, it thus appears, are carried into the air along with the carbon and other constituents of soot and deposited on the more sheltered portions of buildings. It has been shown before that house-coal soot contains a considerable proportion of oxides of iron and alumina and insoluble siliceous matters in the shape of fine coal-ashes. The occurrence of fine coal-ashes in the black crusts thus shows that soot, of the same general character as house-coal soot, was deposited on the stone.

In soot the amount of sulphate of ammonia is considerable, and as the black deposit on the stone shows plainly the presence of other soot constituents, appreciable quantities of sulphate of ammonia might likewise be expected if this salt did not act upon carbonate of lime in the presence of moisture. I have examined several deposits on calcareous stones, but never found more than mere traces of ammonia. The sulphate of ammonia in the sooty deposit in contact with water and the calcareous stone evidently becomes transformed into volatile carbonate of ammonia which escapes and sulphate of lime which remains behind. There can be but little doubt that such a chemical reaction takes place when a smoky atmosphere comes into contact with a calcareous stone, especially if the stone is porous, non-crystalline, and exposed to damp. The dampest, most sooty, and more sheltered parts of buildings are generally much more affected by decay than the more exposed parts. Now this would not be the case if the gaseous constituents of the air were the chief cause of the exfoliations on limestone buildings, for if this were so, I imagine the most exposed parts of such buildings would be more easily attacked than the less exposed. But if the corroding action of the air of towns is, as I believe, more properly ascribed to the tangible portions of soot, it admits of a ready explanation why exactly the sheltered and damper portions of a building are more liable to decay than other parts. In the first place it is evident that soot will be more abundantly deposited in the crevices of fine ornamental stone-work, or in places sheltered by protruding cornices, than on a plain surface wall, freely exposed to wind and weather; in the next place, it has to be borne in mind that, according to a well-known law in chemistry, chemical reactions do not generally take place except the materials which act upon each other are in the most intimate contact, which necessitates either fusion or solution of at least one of the constituents.

In a dry position soot does not produce so injurious an effect as in a damp place, where the sulphate of ammonia contained in it is dissolved by degrees, and retained in solution in the porous stone. Acting upon its carbonate of lime, it will produce sulphate of lime and carbonate of ammonia. In a damp and sheltered position, the conditions for the display of this decomposing action of sulphate of ammonia are evidently more favourable than they are in a more exposed part of a building, where rain will wash away the sulphate of ammonia of soot before it has time to act upon the stone, and the wind in a great measure will prevent altogether large accumulations of soot.

The sulphate of lime produced by the action of sulphate of ammonia upon limestones in the presence of moisture, it is hardly necessary to observe, takes up water of crystallisation, and thereby leads to the exfoliation of the stone. The longer the action of a sooty atmosphere continues upon limestones, the more complete will be their decomposition. In old and thick crusts, like those examined by me, we have seen that more than 60 per cent. of gypsum may occur. Had I merely analysed the surface of the crusts, I doubt not a still larger proportion of sulphate of lime would have been found.

In another specimen of a black limestone deposit from a public building, I found:—

| | |
|---|---|
| Hygroscopic water | 1·07 |
| Organic matters (chiefly fine carbon) | 5·29 |
| Hydrated sulphate of lime | 56·10 |
| Carbonate of lime, oxides of iron, alumina, etc. (determined by difference) | 34·11 |
| Insoluble siliceous matter | 3·43 |
| | 100·00 |

The proportion of ammonia in this incrustation amounted to only ·04 per cent., and that of nitric acid to ·115, which is equal to ·174 of nitrate of lime. Here, again, it will be noticed the sulphate of ammonia of the soot has almost entirely disappeared, and given rise to no less than 56 per cent. of hydrated sulphate of lime.

The effect of a smoky atmosphere on Caen stone is very injurious, particularly if the stone is porous and hygroscopic. I have lately had an opportunity of noticing the rapid decay of Caen stone employed in the restoration of a church. The decay showed itself in less than three years, and was proceeding with such rapidity that this stone had to be abandoned in the work of restoration.

Specimens of this Caen stone, and incrustations formed upon it under the influence of the smoky atmosphere of large manufacturing town, are placed on the table; also specimens of the stone which is now employed, and which resists better the injurious action of such an atmosphere.

The analysis of the incrustation on the Caen stone yielded the following results:—

| | |
|---|---|
| Hygroscopic water | 1·56 |
| Organic matters (carbon chiefly) | 4·54 |
| Hydrated sulphate of lime | 41·78 |
| Carbonate of lime | 38·93 |
| Carbonate of magnesia | ·58 |
| Oxides of iron and alumina | ·33 |
| Insoluble siliceous matter | 11·01 |
| Alkalies and loss | 1·27 |
| | 100·00 |

The amount of alumina in the deposit was only ·038. A nitric acid determination gave ·246 per cent, which is equal to ·371 of nitrate of lime.

Although this deposit was comparatively speaking of recent production, it nevertheless contained a large proportion of hydrated sulphate of lime. Hard crystalline limestones of course resist the action of smoke better than porous soft stones, but it may be questioned whether any description of limestone is well adapted for delicate ornamental out-door work in a smoky town. If the evil of a smoky atmosphere cannot be entirely avoided in places like London, Manchester, Birmingham, &c., every care should at least be taken to mitigate as much as possible the smoke nuisance.

It is not my intention to examine the various methods which have been proposed to render calcareous building stones less liable to decay, for my chief object to-night was to bring before your notice an account of experiments which I made in studying the remarkable chemical changes which oolitic limestones undergo under the influence of a smoky atmosphere. I cannot, however, refrain from saying, that, of all the different plans of protecting buildings against decay, Mr. Ransome's appears best to fulfil the requirements of the case. In the first place, it may be observed, a remedy against decay in stones should have a tendency to render porous stones more impervious to water and atmospheric impurities; and, in the second place, such a remedy should alter the surface of a stone which is so readily attacked by smoke as limestones generally are, in a manner that, instead of carbonate of lime, a compound of lime is produced on the surface which is not readily acted upon by sulphate of ammonia or by acid fumes which are found occasionally in the air of towns. Mr. Ransome's patent process appears to fulfil perfectly the first requirement—that of making a porous stone harder and more compact. The principle adopted in this process likewise appears to be correct, and in a great measure to fulfil our second requirement, for by first impregnating a limestone with chloride of calcium, and saturating it afterwards with a solution of silicate of soda, Mr. Ransome closes the pores of the stone and fills them up with insoluble silicate of lime, a compound which is not acted upon readily by chemical agents. By surrounding the particles of carbonate of lime of which the porous stone consists with insoluble silicate of lime, it will be readily conceived the surface of the stone must be rendered far less liable to be acted upon by atmospheric agencies than the stone in its unprepared state. The perfection of this process would be, if, by some means or other, not only the pores of calcareous building stones could be filled up with a compound, which, like silicate of lime, is not easily acted upon by chemical agencies, but if an appreciable portion of the surface of the stone itself could be changed from carbonate into silicate of lime or into some other equally well-resisting compound, and at the same time the production of soluble salt-like chloride of sodium could be avoided.

In conclusion, I beg to offer a few observations on the injurious effects of smoke on vegetation. Wheat, barley, grass, or clover, exposed to a smoky atmosphere at an early stage of their growth, are visibly affected in a short time. The tops of these plants turn first red, then yellow, and finally white, and an effect is produced not unlike that caused by frost or excessive drought. Corn crops affected in this manner by smoke may recover to a certain extent, but they never yield well, inasmuch as the development of the plants becomes irregular, and the corn ripens unequally. If cereals are attacked by smoke when in flower, the ears do not fill well, and the grain is of a poor quality.

Grass and clover, more or less discoloured or bleached and damaged by smoke, are disliked by cattle, and often rejected by them altogether. Smoke deteriorates the quality and diminishes the quantity of grass and clover crops. Plants with strongly developed leaves, for instance, mangolds, swedes, turnips, and other green crops, are less liable to suffer injury from a smoky atmosphere.

Fruit and ornamental trees, on the other hand, are readily affected by such an atmosphere. The leaves turn yellow, brown, and finally black, and then drop. If the leaves are destroyed two or three years in succession the trees become sickly, and finally die off. Fruit-trees in blossom attacked by smoke yield no fruit, or but a poor sickly crop.

During the combustion of coal much sulphurous acid is generated, which is carried away by the smoke of the fire. The injurious effects of smoke on vegetation are evidently due to sulphurous acid, a gas which, according to experiments made many years ago by Turner and Christison, causes the leaves of plants to drop when it is present in air merely in the proportion of $\frac{1}{10000}$th part.

Recently experiments on the effects of air containing small quantities of sulphurous acid upon vegetation have been made in Germany, by my friend Prof. Stöckhard of Tharand. Young fir-trees exposed twice or three times, for two hours, to air containing only $\frac{1}{20000}$th, or even $\frac{1}{80000}$th of sulphurous acid gas, were completely bleached in wet weather, and killed when they were exposed for a longer time to air containing so small a quantity of sulphurous acid.

In dry weather a much larger quantity of this acid may be present in the air without doing any injury to plants. It is in wet weather that air containing only traces of sulphurous acid is injurious to vegetation. In localities where much coal of inferior quality, generally rich in iron pyrites, is burned, the injury done to vegetation by the sulphurous acid proceeding from such coal may often be seen at a distance of from one to two miles from the place where the smoke is generated.

Farmers residing in a neighbourhood where brick-kilns and potteries abound, frequently sustain much more injury than they are themselves aware. The quantity of sulphurous acid emanating from open brick-kilns is very considerable, and there cannot be any doubt that, in certain localities, the air is poisoned with sulphurous acid gas to an extent which prevents the healthy growth of wheat, barley, or oats, so that good crops are rarely seen in such localities, and blighted ones are quite the rule.

By a recent Act of Parliament provision is made for the effectual condensation of muriatic acid gas in alkali works; but, as far as I know, there is no law which prevents brickmakers throwing into the air any quantity of sulphurous acid which they choose, although it is more pernicious to vegetation than even muriatic acid gas. I have had many opportunities of becoming practically acquainted with the injurious effects which a smoky atmosphere produces on our cereal crops, and regard a strong deposition of soot on wheat and other corn crops quite a sufficient evidence of the more or less complete injury which the crops must have suffered by the sulphurous acid always present in the air in districts where such sooty deposits are seen on plants. The disadvantages of carrying on agricultural pursuits in the potteries, or in districts where volumes of black smoke discharge enormous quantities of sulphurous acid into the air, are well-known amongst the more intelligent and enterprising farmers. This fact explains to a certain extent the backward condition of agriculture in such localities, and loudly calls for a mitigation of the evils to which farmers are exposed who have the misfortune to occupy land in the immediate neighbourhood of large manufacturing towns, or in localities where immense quantities of inferior coal are consumed by brick and tilemakers and manufacturers of earthen and stoneware, &c. Again, in districts where copper-ores, consisting for the greater part of the sulphurets of copper or iron, are the raw materials from which copper-smelters extract the metal, enormous quantities of sulphurous acid are discharged into the atmosphere.

The injury done to vegetation by the smoke from copper-works has been traced beyond a distance of four miles. It is true the smoke from such works generally contains appreciable quantities of arsenic, which of course is inimical to the health of plants; but as the arsenical fumes are insignificant in quantity in relation to the large amount of sulphurous acid which is produced in roasting copper-ores, and as air containing $\frac{1}{40000}$th or even $\frac{1}{800000}$th part of sulphurous acid gas is decidedly injurious to vegetation in wet weather, I think the sulphurous acid of copper-smoke does more mischief to the crops in the neighbourhood of the works than the arsenical compounds of the smoke. Just as little as alkali-makers are permitted to discharge muriatic acid into the air, should copper-smelters be allowed to discharge into the air the enormous quantities of sulphurous acid which are produced in roasting certain copper-ores. It may perhaps not be possible to condense sulphurous acid so perfectly or so readily as muriatic acid gas, and probably the arrangements for the condensation of the former will be found altogether inappropriate to effect the condensation of the latter, but attempts to mitigate the evil resulting to vegetation by sulphurous acid fumes should be seriously undertaken.

It has occurred to me that the sulphurous acid fumes of copper-works might, perhaps, be converted economically into sulphuric acid, or be used for the production of sulphite or hyposulphite of soda; and I do not consider it improbable that one of these days this highly injurious product will cease to be a nuisance to the inhabitants of the country round about the works, and be turned to good economical account.

As regards the actual quantities of sulphurous acid gas contained in the smoke of brick-kilns, we possess no data for our guidance. The quality of the coal used, the construction of the kiln, and the composition of the clay of which the bricks are made must affect to a great extent the proportion of sulphurous acid in the smoke. Thus a coal, with a high per centage of sulphur, but containing also much mineral matter, may produce on burning less sulphurous acid than another kind of coal, poorer in sulphur and in mineral matter, inasmuch as the greater portion of the sulphur is fixed by the mineral portion of some coals. Again, if the clay contains magnesia or lime, or is purposely mixed with chalk, most of the sulphur of the coal will be fixed by the magnesia or lime.

The brick-makers in the neighbourhood of London, who use with the clay a considerable proportion of chalk, therefore produce a smoke which contains but very little sulphurous acid, whilst in districts where fire-bricks, tiles, &c., are largely manufactured from clay that does not contain lime or magnesia, or merely insignificant quantities, the air becomes charged with sulphurous acid to an extent which injuriously affects the vegetation for miles round the brick-clamps or kilns.

Before sitting down allow me briefly to recapitulate the chief points of interest which I have laid before you.

The decay of building stones is connected with much that appears inexplicable or contradictory; I therefore confined my attention to the study of the changes which Caen stone, Bath-stone, and similar calcareous building stones undergo under the influence of a more less impure air.

I endeavoured to show that some—perhaps a good many—calcareous building stones rapidly decay, simply because they are too porous and absorbent, or not of a sufficiently good structural composition to withstand the mechanical effect produced by the expansive force of water. The great enemy to all such stones, and the most important cause of their decay, is damp. It was shown that in such decaying or decayed porous stones the amount of nitrate of lime is too insignificant to attach to it any material influence in producing the exfoliation on limestone buildings. The normal constituents of the air, except moisture, do not appear to exercise any very marked chemical effect upon calcareous building stones.

In the next place, I showed that the destruction of the ornamental work of buildings executed in Bath, Caen, or a similar calcareous building stone, is caused by the formation of crystallised sulphate of lime on the surface. The crusts that may be seen in perfection on limestones covered with soot, were found to consist principally of crystallised sulphate of lime, mixed with the constituents of ordinary house-coal soot, and more or less undecomposed carbonate of lime.

I endeavoured to show that the work of destruction is chiefly caused through the agency of smoke, and pointed out that the active agent of black smoke is sulphate of ammonia, a salt which in the presence of moisture transforms carbonate of lime into crystallised sulphate of lime (the preponderating constituent of the incrustation of calcareous building stones) and into volatile carbonate of ammonia, which escapes.

Finally, I directed attention to the injury which a smoky atmosphere does to vegetation, and pointed out sulphurous acid as the cause of this injury.

It now remains for me to express the wish that some gentlemen in the room, well qualified to speak on the subject brought forward by me, will favour the meeting with suggestions that may ultimately lead to a remedy for, or the mitigation of an evil, the existence of which is but too apparent, and some of the causes of which I have endeavoured to point out.

## DISCUSSION.

Mr. C. H. Smith said his remarks would be of a practical rather than of a scientific nature. He had often been perfectly bewildered by the many scientific theories that had been propounded in reference to this subject. The paper had not alluded to the great variation in quality even in the same description of stone. As regarded Caen and Bath stones, they had been treated as being usually of one quality, whereas it was well-known that in every quarry of this stone there were four or five different varieties, as distinct from each other as possible; therefore it was not right to treat of it merely as Caen stone. The same might be said of Bath, Portland, and all the other oolitic stones. If it were left to the builder or mason, he would soon find out the softest in the quarry, for it could be worked with half the labour that was required for the harder kinds, besides making the finest looking work when it was finished; and it was owing to this often occurring that an almost incredibly rapid decay of the material took place. In every district of the Caen stone there were eight or ten different quarries, and each of these had five or six different beds, so that there were at least fifty varieties of Caen stone, all varying in some respects from each other, and many of them of an inferior character. The decay of the stone in building was therefore in a great measure owing to the bad selection of the material in the first instance. He had seen many instances of this both in London and the country. He could mention many public and other buildings in London and elsewhere, in which the decay of the stone had been almost as striking as in the case of the specimens on the table. The Roman Catholic Church at St. George's was almost as bad as it could be. The structure had been built within the memory of most present, and yet the stone was in a complete state of decay. The materials used were Caen and Bath stone, but not of good quality, and it was therefore, in his opinion, more important to be able to select the best qualities of stone than simply to ascertain their chemical constituents. Generally speaking, the stonemason could tell almost at a glance the good and bad qualities of stone, but it was often not his interest to say anything about it. To give an instance of good and bad qualities of stone of the same kind, he would mention Portland stone, which had been used in London a great deal since the time of James the First. The Chapel Royal in Whitehall was one of the first large buildings erected of that material, and Sir Christopher Wren used it for all his churches. The Monument on Fish-street-hill and Temple Bar were both constructed nominally of the same stone, and whilst the bas-relief representing the great fire of London was as perfect as possible, without a bad stone in it, it was well known in what a state of decay the west front of Temple Bar was, with exactly the same aspect. The different states of preservation of the two buildings were entirely owing to the different qualities of the same description of stone. At Somerset House, again, there was another remarkable instance of this. The river front was built by two different masons, under the same architect. One built the upper part and the other the lower. The part below the terrace was as black as could be, and was at the same time remarkably perfect, the upper portion was almost white, and there was scarcely a good stone it it; yet both portions of the building were of the same aspect, and the portion nearest the water was perfect, while that which was farthest from the water was very much decayed. It was after the bad stone had been used that chemists were set to work to try and find out something to stop the decay of our large public buildings, whereas the better plan would have been to have taken more care in the selection of the stone. He believed several thousand pounds had been expended upon the Houses of Parliament in trying processes to prevent decay, but up to this time he was not aware of any plan that was practically useful. A specimen was put into his hands some time ago to show how far the indurating material employed in one of these processes had penetrated into the stone, and he found that it had entered as far as three quarters of an inch, but that stone had been in the first instance put into a hot air chamber to drive out all the moisture, and afterwards immersed in the boiling fluid, and by that means this result had been produced; but he need hardly say that it was not possible to put the Houses of Parliament or Somerset-house either into a hot-air chamber or into a boiling fluid. Those appliances answered in the laboratory but not in practice. His own opinion was that any of the substances at present known applied to the preservation of stone would not be neutral in their effects,—they would either tend to preserve it or to hasten its decay. A great deal had been said in the paper as to the effect of water on stone; his own belief was, that if the stone was really good the water would have little or no effect upon it. By experiments he had made, he found that a cubic foot of Caen stone would absorb two gallons of water without showing more than a slight dampness on the surface. Hardly anything was more absorbent of water than a well-burnt grey stock brick, yet it was a very durable material. Mr. Smith referred to the church of St. Dunstan, in Fleet-street, as an example of exceedingly porous limestone exposed to the London atmosphere, and yet it had proved very durable. The decay of bad quality of stone was by no means restricted to London or other large cities, the atmosphere of which was impregnated with the acids, &c., to the effects of which the destruction of stone was attributed by scientific men. The town of Oxford presented a remarkable instance of this. He knew of no town in so deplorable a state in this respect, and he attributed it entirely to the injudicious selection of the quality of stone. The effects of varieties of temperature upon stone had not been sufficiently taken into account. The extreme differences in the temperature of winter and summer in this country might be stated at 100 degrees. That, in his opinion, had more effect in producing the decay of stone than anything else. Take the case of a building exposed to two different aspects, such as the Horse Guards, which was built throughout as nearly as possible with the same stone. The north and east sides of that building were blackened and in a perfect state, while the decay was principally observable upon the sides facing the south and the west, owing as he believed to the greater variations of temperature to which they were exposed. Dr. Voelcker had implied that limestones were unfit for outdoor carvings, and if so he should be glad to know what sort of stone was suitable, because they could only carve at great expense in sandstone, and, moreover, it was more or less laminated, and, in order to be durable, required to be put up in the position in which it was laid in the quarry, otherwise it became exfoliated.

Mr. G. F. WILSON, F.R.S., thought that Dr. Voelcker had treated this subject in a strictly practical manner. When a scientific chemist in the position of Dr. Voelcker explained what the particular form of decay in the stone was, showing that so large a proportion as 50 per cent. of sulphate of lime was present, it must direct the attention of practical men to the importance of using those particular kinds of stone which were not so liable to be acted upon by the sulphate of ammonia in the sooty atmosphere. The remarks of Mr. Smith, as to choosing the best portions of stone in a particular quarry, were very important. Dr. Voelcker attributed the decay of particular kinds of stone to the corroding effect of the black smoke of large towns forming an incrustation which reacted on the stone, somewhat in the same way as tartar acted upon the teeth, only with a different chemical reaction. That subject had been treated of several times in this room, and the different modes of getting rid of the smoke which occasioned the evil had been considered. A very simple method of preventing smoke in house fires was stated to be the having a grate with a false bottom and putting the coals in below, and removing them when in a glowing state from the bottom to the top of the grate.

Dr. BACHHOFFNER remarked that, judging from what had fallen from his friend Mr. Smith, every architect should be a Hugh Miller; but he thought very few architects could give that time to the study of geology which was requisite to bring them up to the practical standard suggested by Mr. Smith, as judges of the different qualities of stone. Hence the advantage of this Society and of the admirable paper brought before them this evening. He had not heard anything in the remarks of Dr. Voelcker as to the discarding of limestones, and he apprehended that their disuse for ornamental purposes was not suggested; but the novel point with him, and one which was of considerable importance, was the action of the sulphate of ammonia in the soot producing double decomposition, and thus contributing to the decay. He knew no reason why every household should not be made to consume its own smoke. Mr. Wilson had alluded to a plan which he (Dr. Bachhoffner) patented some years ago, but no one would take the trouble to employ it. It had been shown by Dr. Arnott and many others that the proper way of lighting a fire was from the top. Lighting from the bottom was a wasteful plan, for the heat distilled the coals at the top, and their heat-producing qualities were thus to a great extent lost. A fire lighted in the way he had just recommended would remain alight for four or five hours, and require no stirring. He thought Dr. Voelcker was quite right in saying that smoke was the cause of the destruction of stone in buildings, and he supposed they must submit to this till the legislature made it imperative that every house should consume its own smoke. The table in the paper showed them that whilst the original composition of stone contained only one-tenth per cent. of sulphate of lime, in the decayed stone 51 parts out of 100 were converted into this salt.

Mr. F. A. Abel remarked that there was no doubt the facts brought before them in this paper formed an important contribution to our knowledge as to the various causes which brought about the decay of stone. Mr. Smith had properly called attention to the importance of selecting proper descriptions of stone, of uniform quality, in future buildings, but it must be remembered that we had to deal with buildings already erected. With regard to the effects of moisture and of the different salts contained in soot, they were deserving of great consideration. Those who had given attention to the decay of stone would have noticed that where the stones remained moist, as they would in some parts of a building, there the decay was greatest. This was not alone owing to the disintegrating action of the moisture, but was due, in a great measure, to the absorption of the saline materials which constituted so large a proportion of the composition of soot. On one point he differed from Dr. Voelcker—that was as to the preservation of stone by artificial means. He had led them to believe that such a process as Mr. Ransome's would be successful. In that he (Mr. Abel) did not agree. In the composition used by that gentleman there were different salts, which, by chemical reaction, were intended to deposit an insoluble substance upon the surface and within the pores of the stone. Doubtless this insoluble substance, silicate of lime, was produced, but there was also produced a soluble substance, common salt, which soon dissolved away and left the pores of the stone open. The result was, the stone was not permanently protected; indeed, not more effectually than if some such substance as beeswax was applied, which for a time would fill up the pores of the stone, but would soon decay and require renewal. If they could discover a process (and he did not despair of this) by which they could get a preservative matter into the pores in a perfectly insoluble form, it would no doubt be valuable. To that end they were tending. He believed it was not impossible to deposit silica in a hard form in the pores of the stone without also depositing a soluble salt, and in this way they would effect what Dr. Voelcker had shown to be so desirable to prevent the decay of stone.

Mr. Tracy remarked upon the circumstance that, although there were evidences of the failure of portions of the stone in the front of Westminster Hall, the same description of stone had been used for the New Houses of Parliament. He would put in a plea on behalf of soot. In his opinion, the carbon which was deposited on the roofs of the houses in the form of soot, and afterwards washed away by rain, and conveyed into the sewers, acted, in a great degree, as a deodoriser of the sewage matters, and in that way was beneficial in a sanitary point of view.

Mr. Bishop could state that what had been treated of as occurring to buildings in this country took place to a considerable extent in other parts of the world, under totally different climatic influences. The English church at Alexandria, although erected only six or seven years ago, in sandstone, already exhibited signs of decay in some parts, particularly in the ornamental portions, whilst the mosques in Cairo, which had been built hundreds of years, also of sandstone, were in the most perfect preservation, and the richly-ornamented domes of those buildings, exceeding anything we have in this country, remained perfectly sound. Damp had been spoken of as having a great effect upon some description of stones. In Alexandria, however, there was no rain whatever for eight months in the year, but there was a palpable dampness in the atmosphere of an evening. He had no doubt the stones took up a great portion of that dampness. On visiting the obelisk at Heliopolis, on the sides on which the current of wind set, there was an incrustation nearly half-an-inch thick, with slight vegetation upon it. That appearance was presented on only two sides of the obelisk, and there must be some considerable degree of moisture to fix that earthy matter. A similar appearance was presented by the stones all over Egypt; there was something deposited on them which would produce vegetation if there was sufficient moisture for that purpose. With regard to the destructive influences of frost upon stone, they were, no doubt, considerable, though in many places in the East, where there was no frost, the stone was nevertheless much decayed. The Coliseum at Rome, though built of a very porous stone, was in excellent preservation. The Cathedral of St. Peter was built of the same kind of stone, as were most of the buildings in Italy which were not of marble; it was very porous, though also very durable. The Cathedral of Cologne appeared to have suffered from the decay of the stone more than any similar building in this part of Europe, and many portions had to be entirely rebuilt. With regard to Caen stone, as far as his own knowledge went, it appeared that those stones which contained the greatest portion of silica were the best resistants of the influences of the weather.

The Chairman proposed that the thanks of the meeting be given to Dr. Voelcker for his paper. This paper was of a highly practical character, containing as it did a collection of chemical results obtained by experiment upon decayed stones taken from various buildings. It was true that no remedy had been suggested in the paper, but perhaps that was not the object, but rather that of eliciting discussion and information. This was the kind of paper most likely to bring out that information, either as to what stone should be avoided, or how to make the material employed more durable. Mr. Smith had given them another set of facts, those of his experience as to the differences between one bed of stone and another. He had also shown how, in the same building, different degrees of disintegration in the same description of stone had taken place. Taking the instance of Somerset House, he had stated that the lower parts and those nearest to the water had suffered less than the higher portions of the building. Then, with respect to the Horse Guards, Mr. Smith had told them that the northern and eastern portions were less decayed than the southern and western, and this he attributed to the greater change of temperature to which the latter were exposed, but it must be remembered that these were also exposed to the winds most prevalent in this country; therefore, the condition of the stone being originally the same, we must infer that the sides of the building exposed to the winds and rains nine months out of the twelve would be mechanically acted upon to a greater extent than the other parts, and there would also be a larger quantity of sulphur salts thrown upon those portions. Those causes combined, no doubt produced that difference which Mr. Smith had very truly stated. Here were the observations of a practical man pointing out where the decay took place, but he did not show them how the evil was to be avoided. Dr. Voelcker had shown them the chemical changes which took place in certain descriptions of stone, and in the case of the specimens of dilapidation exhibited this evening, it appeared that this destruction was going on while the restorations were in progress, so rapid was the decay in some instances. He begged to propose a cordial vote of thanks to Mr. Voelcker for his valuable paper.

The vote of thanks was then passed.

The Secretary called attention to a form of ventilator patented by Mr. Boyle, sent for the inspection of the members. It consists of circular apertures in some of the upper panes of a window, covered with wire gauze, and also openings at the lower portions of the room similarly covered, for the admission of fresh air. The inventor states that the effect of the gauze is to distribute the air, so as to avoid draught. Attention was also drawn to a clock case, in engraved metal work, after the style of monumental brasses, the engraved portions being filled in with lac of various colours, executed by Mr. Alfred Woodall.

The Secretary announced that on Wednesday evening next, the 27th inst., a Paper by Mr. Samuel Brown, F.I.A., F.S.S., "On the Metric System of Weights and Measures, and its Proposed Adoption in this Country," would be read.

## Proceedings of Institutions.

Bank of England Library and Literary Association.—On Tuesday evening, the 12th of January, Thomson Hankey, Esq., M.P., delivered a lecture in the reading-room of the Institution. The chair was occupied by K. D. Hodgson, Esq., M.P., Governor of the Bank, who stated that the lecturer had taken a leading part in founding the society, and had shown great interest in its progress. Mr. Hankey chose for his subject "One Year of Government Expenditure; or, how the money comes in and goes out." He first dealt with the cash account of the Treasury from the 1st of April, 1862, to the 31st of March, 1863, specifying the amount expended by each department of the Government, and explaining how the various items were made out. The total ordinary expenditure for the year was £69,302,007 19s. 2d. He then went through the items of revenue in the same way, showing what the several departments produced, with the cost of collection. The ordinary income was £70,604,560 15s. 3d., being £1,302,552 16s. 1d. in excess of the expenditure. He pointed out, however, that in addition £1,050,000 had been expended on fortifications, reducing the excess of income over expenditure to £252,552 16s. 1d. Mr. Hankey concluded his lecture by paying a high tribute to the honour and integrity which in the present day characterised our public servants. At the conclusion of the lecture Mr. Matthew Marshall, President, in moving a vote of thanks to Mr. Hankey, reminded the members that thirteen years previously Mr. Hankey had opened that reading-room, and that his presence on this occasion was only another proof, if such were wanting, of the continued interest taken by him in the prosperity of the association. Mr. Hankey, in acknowledging the vote of thanks, assured the members of his continued interest in the prosperity of the society, and concluded by moving a vote of thanks to the Governor for his kindness in presiding. This was duly passed and acknowledged.

Brompton Church of England Young Men's Society.—The thirteenth annual report states that the debt originally incurred for the furniture and apparatus for the lecture room is steadily decreasing, and is now almost entirely discharged. The attendance at the public lectures, and at the Tuesday evening meetings, has not been so satisfactory as could be wished. The committee desire it to be known that these lectures are invariably a pecuniary loss to the society, and that an increased sale of tickets to non-members is necessary to justify the committee in incurring the expense of providing for future lectures. The literary class continues to afford to members an opportunity of improving themselves in elocution, composition, and in general information. The committee appeal to the friends of the society for donations of books or money to augment the library. The weekly exchange of periodicals at the members' homes continues to be appreciated. A reading room, supplied with newspapers, chess, and draughts, has been opened for members, at a payment of 1d. per week. The income has been £42 15s. 10d., and there is a small balance due to the treasurer.

London Mechanics' Institution.—On Wednesday, the 13th inst., a *soirée* was held at this Institute in commemoration of its 40th anniversary. The theatre and reading-room were decorated for the occasion; the walls were covered with pictures, and numerous objects of scientific and artistic interest were exhibited. The chair was taken by Mr. T. A. Reed, who, in opening the proceedings, delivered a short address, in which he referred to the establishment of the Institution, the first of its kind, in 1823, by Lord Brougham, Dr. Birkbeck, and others, and to the national benefits which had sprung from the many similar societies called into existence by its example. Addresses were then delivered by Mr. Joseph and Mr. Rees, members of the committee of management. The entertainments of the evening comprised singing and recitations, and the exhibition of dissolving views, &c. Dancing was kept up till a late hour. An announcement made during the evening, that the chairman had brought before the committee of management a proposal for supplying the members with refreshments at cost price, with the view of ultimately incorporating the club principle with the general working of the Institution, was greeted with applause.

Shropshire Mechanics' and Literary Institution.—The report for the year ending 31st December, 1863, speaks of its great and perhaps unprecedented prosperity. The income was £202 8s. 4½d., and there is a balance in the hands of the treasurer of £54 13s. 9½d. There has been a large increase also in the number of members, at present nearly 200, being twenty-five more than the total of last year. The committee express their obligations to various gentlemen who have contributed by lectures and otherwise to the success of the past year. Large audiences were attracted by the professional lecturers, Mr. Grossmith, Mr. Rowton, and Mrs. Inglis. For the last two years no classes have been in operation owing to the absence of any want having been expressed in this respect; but the committee reiterate their readiness at all times to assist in promoting classes in any of the useful arts or sciences, and to provide a comfortable class-room for this object.

Southampton Athenæum.—The half-yearly meeting was held on Wednesday, January 13th, when there was a good attendance of members. The chair was occupied by Mr. W. Johnson, vice-president, who referred to the satisfactory manner in which the Athenæum had progressed during the past year, the subscriptions having increased from £34 in the previous year to £56 5s. 7d. in the last, and the entrance fees to lectures from 15s. to £15 6s., so that the committee had been enabled to clear off some of the liabilities; the total income for the year being £140 11s. 2d. The report, which was read by Mr. J. Locke, the corresponding secretary, stated that the various classes in connection with the institution now numbered ten, and were in active operation, under able and qualified masters. The lectures were highly successful, and, as well as the classes, had been the means of increasing the number of members. The reading-room was kept in a most efficient condition. An addition had been made to the library, the president (Mr. Steuart Macnaghten) having made his customary present of books, consisting of eighteen volumes; others were added, and a still further increase was recommended. In conclusion the committee reported an addition of 179 members since December, 1862, and that a good list of lectures had been made up for the next session. The balance-sheet showed that the balance in the treasurer's hands was £7 18s. 1d., and the liabilities had been reduced some £23. Steuart Macnaghten, Esq., was re-elected president. This society has been established since 1849. It offers to its members fortnightly lectures, a circulating library of 800 volumes, a reading-room supplied with the principal reviews, and daily, weekly, and monthly publications, also the privilege of attending several of the classes of the society, including elocution, reading, discussion and dramatic, all for the payment of one penny per week. There is also a coffee and club room, where chess, draughts, &c., are available for the payment of sixpence per quarter additional.

## Manufactures.

### REPORT ON THE IRISH FLAX CROP OF 1863.

By Wm. Charley, J.P.

No doubt some of the readers of the *Journal of the Society of Arts* will recollect the series of papers I contributed to its pages on the subject of flax. Those papers I afterwards collected and published in a small volume.* My object in doing so was to place within the reach of every one requiring such information, a *resumé* of everything known on the subject up to the present time, and to place the cause of flax cultivation before the public in a popular and accessible form. No doubt other parties have made most laudable efforts in the same direction, but their exertions have generally been confined to some special branch of the flaxen industry; and not one, that I am aware of, has endeavoured to grapple with the entire subject from the sowing of the seed to the completion of the finished fabric. This task I have endeavoured to accomplish, and though no doubt a difficult one, I hope and believe, with the valuable aid I received, when sought for, from many kind friends, that the result has been tolerably successful.

I am induced to make these remarks not in a vain or boastful spirit, but because the increased growth of flax, which I have so warmly advocated in the Society's *Journal*, is now an accomplished fact. This is no doubt partly to be ascribed to the continued attention paid to the subject by the public press, and other organs of opinion. The extremely low price of grain and the very unfavourable weather for harvesting for some years past, making the quality inferior, as well as the quantity, in comparison with ordinary years, induced many hitherto prejudiced farmers to try the much-talked-of flax crop in 1862, and a still larger number in 1863, the acres for those years being respectively 150,070 and 213,992.

The price of flax has kept up, and is at a very remunerative figure at present, while the yield and quality of fibre is decidedly beyond the average. My crop of 1863 produced £24 per statute acre, one-half of which I consider to be clear profit. A friend of mine, an amateur agriculturist, tried one field this last season for the first time, and off three acres, sold in Belfast market £65 value of produce. A still more interesting case is that of a respectable farmer residing close to my place, who told me the other day he had £106 off one field of 4¾ acres, the half of which he considerd clear profit, and without which he would have had some trouble in making up his rent.

These crops are all rather over the average, and are the produce of good warm soils in the Valley of the Lagan; but much of the flax is grown on cold, high-lying land, almost mountain land, and the result in such cases would not exceed perhaps half what I have mentioned.

Mr. Macadam, Secretary to the late Royal Flax Society, estimated the average produce per acre at 5 cwts., which at £3 per cwt. gives £15 per acre; and I think, making due allowance for the "high land" and other inferior crops, this calculation is very nearly correct. The value, therefore, of the Irish flax crop this year, would be £3,209,880. It is estimated that the entire flax-spinning power of Ireland is now about 650,000 spindles, equal to 65 large mills of 10,000 spindles each, each mill requiring in ordinary times 500 tons of flax fibre per annum; but as the present demand is chiefly for low, heavy qualities of yarn, one-fourth may be added this season, making say 625 tons, which, multiplied by 65, gives a total of 40,625 tons; the value, at £60 per ton, is £2,437,500. This leaves a surplus for sale to Scotch, English, and foreign spinners of £772,380, supposing only Irish flax to be used in Ireland; but as Irish spinners buy largely of foreign flax, we have a surplus of over one million value for export to Great Britain, where it is so much needed. This surplus exceeds the entire value of the Irish flax crop 15 or 16 years ago, and if the present demand remain steady, and linen fabrics continue to be used as substitutes for cotton, millions of money lately sent to the United States for raw material will be kept at home, and the wealth and prosperity of Ireland no doubt greatly increased.

This part of the United Kingdom possesses every capability for an almost unlimited cultivation of flax; even the almost useless bogs, if drained, would become further auxiliaries.

The importance of the crop to the Irish farmer is now recognised. In fact, it is admitted, that instead of the "wheat paying the rent" in 1863, so far as Ulster is concerned, it has in many cases been the flax. Wet seasons and low prices have acted severely against the cereal crops, but have not affected the value of the flax crop; while the scarcity and dearness of cotton itself, has so well sustained the prices of all articles used as cotton substitutes, that a more than average rate for flax has lately been obtained. The following tabular statement will show the acres of flax grown in Ireland for some time back:—

| | English Acres. | | English Acres. |
|---|---|---|---|
| 1847 | 58,000 | 1856 | 106,311 |
| 1848 | 53,863 | 1857 | 97,721 |
| 1849 | 60,314 | 1858 | 91,646 |
| 1850 | 91,040 | 1859 | 136,282 |
| 1851 | 140,536 | 1860 | 128,595 |
| 1852 | 137,008 | 1861 | 147,866 |
| 1853 | 174,579 | 1862 | 150,070 |
| 1854 | 151,403 | 1863 | 213,992 |
| 1855 | 97,075 | | |

"The total area under flax this year (1863) amounts to 213,992 acres, which exceeds by 39,413 acres the greatest extent sown in any year since these statistics commenced in 1847." (See *Abstract of Agricultural Statistics, Ireland, prepared by Mr. Donelly, Registrar-General.*)

My advice to all parties anxious to try the cultivation of flax is to inform themselves first as thoroughly as possible on the subject, and then "try their 'prentice hand," by beginning on a small scale for the first year. If half an acre be successfully grown at the first attempt, there is nothing to prevent due extension thenceforth, but it is unwise to increase largely till experience is first acquired. I think in England, the cultivation of flax might be greatly extended with benefit both to the farming and manufacturing classes.

In Ireland the increased growth during the past two years has been attended with the happiest consequences; and though I do not mean to say that flax cultivation is the only panacea for the so-called "distressed agriculturist," I do say that at least for some years to come there is every prospect of a high range of prices for flax fibre, and consequently of good profits to the farmer; while the fact that the flax crop does not suffer much from wet harvests, owing to its being pulled early in the season, is a further inducement to extend the cultivation, especially in those districts that have suffered so much of late from badly saved and deficient crops of grain.

Seymour-hill, near Belfast, Jan. 1, 1864.

Disease among the Potters.—The workers in the potteries suffer from diseases incident to their calling, and some portion of the unhealthiness no doubt arises from causes which, to a large extent, might be removed. The handle-makers and hollow-ware pressers injure their chests by pressure on their moulds; and the chests of the throwers, flat-pressers, and cup-makers, &c., are compressed, and the healthy action of their lungs is impeded by the peculiar posture, and intense pressure of their arms, in work. The manufactories built by past generations are insignificant, mean-looking, dirty monuments of the ignorance and poverty of the past, built in ignorance of all the laws of utility and of beauty. The area of the workshops around the stove-rooms is generally much too limited to be compatible with the health of the workman; the means of ventilation are, in many instances, not provided, and in others they are so unwisely fixed as to cause drafts, while the workmen, in their ignorant preference of warm air to the pure, frequently exclude the air altogether by closing the ventilators; they thus breathe an atmosphere which renders them extremely susceptible of catarrh and all its consequences. The air is also laden with carbonic acid gas and vapour, and is thus partially poisoned by the decomposed matter of their own bodies, which ought to have the means of escape, to prevent its return to the lungs from which it was exhaled. This warm and impure air is also laden with dust. The dust from textile fabrics is not very inimical to health; but clay dust is infinitesimally fine, and, from its affinity to water, it readily combines with the watery element, whether in the form of liquid or vapour. It thus chokes up the minute pores of the skin, and clogs up the extremely delicate and fine air cells of the lungs, impeding their freedom of action. Unfortunately for the interests of health the dust is white. It is a clean looking dirt. Were it black, like that of the sweep, or coal-miner, or the worker in iron, the worker in clay, like other workmen, would daily wash the entire surface of his body. A complete and frequent ablution is necessary, for the fine white dust works its way through his clothes, and, combining with the insensible perspiration, it forms a layer of white dirt over a coating of natural scurf, and thus cakes him over with a thin layer of clay, which impedes the respiration of the skin. It is no marvel, therefore, that bronchitis, consumption, and asthma, above all, should afflict the workers in clay, and shorten their lives; nor is it any wonder that the paucity of hale old men should strike the attention of a stranger. The victims of the "potter's disease," as it is sometimes designated in the certificates for burial, go to their graves in units, and the fatal malady is insidious and slow, and but little notice is taken of it; but to the individuals, and to society as an aggregate, the result is the same as when a frightful accident comes upon the public with its multitude of victims. It is really a process of slow poisoning, and the public suffers with the sufferings of each individual victim. The evil arises partly from the foolish practice of sweeping the workroom in the morning. The dust is very dry, and cannot be swept except in a dry state. Motion causes it to float in the air, and its specific gravity is so light that it continues to float and to be inhaled as long as the worker continues to work. And yet the remedy is simple. Let each workshop be swept the last thing at night, rather than the first in the morning, and the injurious element will have many hours in which to settle, the stillness of the night air will be favourable to the process, and, in the morning, the lungs may receive their natural food more free from the impurities which engender asthmatical affections. But the sufferers are not blameless. Highly skilled as very many of them are in their artistic and beautiful work, they evince thoughtlessness and ignorance of the laws of health. If ventilators be provided, they keep them almost hermetically closed. If a window be fixed in the wall of the stove-room, it is allowed to be as dirty as though it had only a decennial cleaning, and to be broken, as if to admit the hot steaming air of the stove-room into the work-room. But their greatest mistake is in the irregularity of their working hours. The penalties cannot be commuted; they are always paid in full, for nature is inexorably just in her chastisements, as she is beneficent and prodigal in her gifts. But this is not the worst, for the misguided toilers feast themselves in their sloth, and then go on short commons in the days of prolonged and hard toil. No legislation can enforce the observance of every natural law, nor can any doctor of medicine cure a man's bad habits. Men may and must do those things for themselves which no others can do for them. Over-hours work is a deception to the manufacturer and an injury to his men. The most decisive testimony from several intelligent and experienced foremen shows that the average result of the over-hours system yields no more work than the ordinary hours of labour. If men do too much one day they cannot but do less on the next. Six or seven o'clock should terminate labours which begin at a proper morning hour. Were the manufactories to be regularly and absolutely closed at a given hour, a sufficient motive would exist to induce workmen to begin to work at an early hour of the day, and on the earliest day of the week; and thus regularity, health, and domestic comfort would be promoted, and the manufacturer would have greater reliance on his workpeople in the execution of his orders. The potters do not generally work more hours in the week than the operatives under the Factory Act, but the working hours per day are more unequally divided, and the workmen, those of a few manufactories excepted, do not, as under the Factory Act, cease work soon after noon on Saturdays, so as to have Saturday afternoons for marketing, garden labour, and open-air recreation. Many practical improvements may be, as many have been, introduced by the sound judgment and experience of masters and of workmen, apart from law; for it is the common interest of all to do what is just and wise; but that great ameliorations are still needed is clear, from the fact that few, even of the most moral and religious of the workers in clay survive the period of middle life, that potting is more injurious to health even than mining, and that in one instance the foreman of one of the largest and best regulated manufactories in the Potteries, in which his life had been spent, declares that though he himself is not sixty years of age, he has in his time seen almost the entire body of the workpeople there swept away two or three times by death, and that in all probability, had he not risen to his position in comparatively early life, he also would long since have shared the same doom. The early ages at which the children begin to toil, and adults begin to die, are to be almost equally deplored. The former are cutting papers, turning jiggers, and running moulds, when they ought to be conning their lessons at school, or enjoying boisterous merriment in the streets; and in the latter the incipient process of decay begins almost before they are men. Our potters, are, as a body, a pale-faced and comparatively young race of men; few live beyond the age of forty-five.

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* "Flax and its Products in Ireland." By Wm. Charley. Bell and Daldy, 186, Fleet-street, 1862.

## Commerce.

**African Coffee.**—Africa can produce coffee unsurpassed by any other in the world. Some samples from Western Africa have been pronounced equal to the finest Mocha. The tree is easy of cultivation, bears after four or five years, and requires but a moderate amount of care. In 1753, the first coffee tree in Brazil was planted in a garden at Rio. Little by little the coffee tree found its way to all the sugar plantations, small quantities only being grown for private use; but when St. Domingo was in revolution, at the close of last century, a coffee planter found his way thence to Brazil. He commenced cultivation for export. From that little coffee plant in the garden at Rio, one hundred years ago, nearly half the present consumption of the civilized world is now derived. Now, as coffee can be grown anywhere over thousands of miles in Africa, at a short distance from the coast, and as the civilized world could even now consume double the present supply of coffee, this useful berry may be looked to with hope and confidence as one of the instruments for African regeneration. Upwards of 100,000 trees have been set out during the last season, in lands on the St. Paul's River. It has been tried with great interest on the Gold Coast. Natal has become an exporter of it to a small extent. The cultivation of coffee will not interfere with that of any other staple. There seems little doubt that among the rich produce derived from the interior, coffee of the best quality will, in the course of a few years, figure in our markets in considerable quantities, with cotton and other absolute necessaries of our civilization and our manufacturing industry.

**British Salt.**—The export trade in this article to India, although restricted to Calcutta, has largely increased of late years. Within the last three years the shipments have doubled, and now average 180,000 tons.

If the monopolies which exist in China, Siam, the Dutch Indian possessions, and other eastern countries were abolished, a large field would be opened for the supply of British salt to the millions of population in the far East.

Cotton from the Gold Coast.—A small shipment, received lately by the Company of African Merchants at Liverpool, realised 2s. 1d. per lb. The Egyptian cotton seed, sent out to the Gold Coast last winter by the African Aid Society, has been planted with great success. The cotton produced from it is more abundant, and the quality better, than that grown from indigenous seed. France is fitting out expeditions for extensive cotton planting in her Senegal colonies.

## Colonies.

### CHINCHONA CULTIVATION IN JAMAICA.

The following is the report on this subject recently made to the Governor of Jamaica, by Mr. Nathaniel Wilson, the island botanist:—

The most important event in the history of the Botanic Garden of this island for many years past, has been the introduction, by seeds, of the quinine-yielding Chinchona. In the autumn of 1860, and by the month of October in the following year, I succeeded in rearing over 400 healthy plants, quite ready for planting out, but unfortunately the selection of a proper site for their final establishment was overlooked; and consequently the subsequent treatment the plants had to undergo proved destructive to one half their number. However, being wishful to prove, by every means in my power, the result of the experiment of testing the adaptability of the plants (constitutional and climatic) for cultivation in the higher altitudes of this island, finding the climate of Bath, as the summer approached, by far too warm, I had the whole of them removed in small pots to Cold Spring Coffee Plantation, St. Andrew's mountains, the elevation being about 4,000 feet, and placed under artificial treatment. I soon found the climate and soil of this locality to be all I could desire for the plants; and as it afforded every facility for carrying out so valuable an experiment, I at once availed myself of it, and planted out in the Coffee fields, on the 15th November, 1861, several plants of each species, then about two or two and a half inches in height. In 12 months after, a plant of the red bark (*Chinchona succirubra*) had attained to the height of 44 inches, with leaves measuring 13½ inches long by 8¾ inches broad. The same plant, now two years old, measures six feet in height, with 10 branches, having a circumference at base of stem of four and a half inches.

The *Chinchona nitida* and *Chin. micrantha* (grey barks) being of more slender habit of growth, have not made so rapid progress; the highest has attained five feet, with three branches; the leaves however are larger, and measure 14 by 10 inches. So far the experiment has thus proved eminently successful; indeed, it would be difficult to find more healthy trees in the neighbourhood; and in about three or four years hence they may produce seeds. In the meantime they can be largely increased by cuttings and layers in the hands of a skilful propagator.

During the first 12 months of the above-mentioned period, the collection remained in this locality under artificial treatment, in charge of a person who was quite unacquainted with their management, resulting in a serious loss of plants. During this period also, there were about 30 plants distributed to applicants, having a suitable climate for their development, but I have not been favoured with a statement of results, with the exception of those (15 in number) planted out in Cold Spring and Clifton Mount Coffee Plantations, all of which are doing well.

During the months of August and September, 1862, the collection was again returned to Bath; the plants were at this time eighteen or twenty months old, a critical period for forest trees in flower-pots, under unskilled treatment, and in a climate, too, which from its uncongeniality would have soon terminated their existence, had they not shortly afterwards (13th October) been planted out at Mount Essex, near Bath, at an altitude of 2,000 feet or little over. This site, as a temporary one, was had recourse to to save the plants alive until a better one could be obtained, and so far it has answered the purpose, and a majority of the plants are healthy, but have not made so fast progress as could have been desired. The soil is too loamy and adhesive to admit of a free and rapid escape of the heavy rains, which fall here in torrents during the greater part of the year. The altitude is by far too low for the Peruvian barks, and a few of the plants have died since they were planted. The red bark thrives best at an altitude of 3,000 feet, and, being a more hardy tree, the plants are more healthy, but as they are not yet too large for removal, I should recommend it being done during the cool months. A very important fact has now been established, viz., that the climate of our higher, and many of our intermediate mountains, is suitable for the growth of the most valuable species of quinine yielding plants, the *Chinchona succirubra*, and also a knowledge of the method of increasing the plants, and the soil best adapted for their full development has been obtained. Another most important discovery has lately been made in India, respecting the febrifugal virtues of the leaves of the red bark as they fall from the tree. An infusion of the leaves, in doses of one fluid ounce, was given to the first four cases of intermittent fever that occurred in the Civil Hospital of Darjeeling, and in every case the patient was cured without any other medicine whatever. The barks are found to yield as large a per centage of quinine in India as they do in their native forests.

The plants being lately established in many parts of the world, and success in growing them to perfection made known by practical experiment, cannot do otherwise than influence their cultivation immensely, conferring benefits of a domestic and commercial nature of no ordinary import. If it is intended to do justice to the plants from henceforth, the experiment has arrived at that stage which will admit of no further delay in removing them to a proper clime, and putting them under a system of management that will secure success in all practical operations connected with the plantation, so that the plants may rapidly be multiplied.

Victoria Goldfields.—The recent heavy rains have caused great inconvenience to the miners, and have much delayed the opening of new goldfields that are known to exist. The largest nugget recently found weighed 176 ounces.

Agriculture in Victoria.—The *Melbourne Argus* says:—Favoured by continued fine weather, our crops promise a gratifying abundance; feed is plentiful, sheep-shearing is well advanced, and the wool of this year will be found very superior in strength of staple and fulness of growth, whilst the total quantity of the clip will be large. The number of high-bred sheep in this colony increases greatly every year, and the flocks of many breeders are attaining a high repute. The improvement of the breed of sheep will be much forwarded by the result of the late Intercolonial Champion Show held here recently, when large prizes were adjudged to sheep reared in this colony, which now promises to take a high position in the competition with other Australian colonies.

Time Ball at Adelaide.—In imitation of the ball at the Royal Observatory at Greenwich, a similar arrangement has just been completed at Adelaide. The time ball was lowered for the first time on the 19th October.

Burra Burra Mine.—The quantity of copper ore raised in this mine during the last six months has been 4,438 tons, showing an increase of 233 tons on the previous six months. The cost of production was £44,349 2s. 8d., and the amount realised £51,936 6s. 6d., showing a profit of £7,587 3s. 10d.; total profits, inclusive of other sources, £8,393 6s. 3d. The average produce of the 4,438 tons was 23 per cent. of pure copper.

THE MELBOURNE CUSTOMS RETURNS are favourable, and show a considerable increase upon the same period of last year. The figures are as follow:—

| | |
|---|---|
| Imports, January to November, 1862 ... | £11,570,157 |
| " " " 1863 ... | 12,139,318 |
| Increase... ... | 569,161 |
| Exports, January to November, 1862 ... | £10,322,812 |
| " " " 1863 ... | 10,550,275 |
| Increase... ... | 227,463 |

WINE IN SOUTH AUSTRALIA.—The vintage promises very favourably this season, and a large quantity of wine will probably be made. It is desirable that arrangements be made for the storing of the wine here a sufficient time before it is shipped, instead of allowing it to be sent off in its crude state.

VICTORIA.—TRANSPORTATION.—The Anti-Transportation League of Victoria have put forth a statement and appeal to the people of Great Britain, in which they protest against the report of the Royal Commissioners on Penal Discipline recommending transportation to Western Australia. They draw attention to the fact that Western Australia possesses several ports accessible to ships, at one of which, King George's Sound, the mail steamers and other vessels to and from the eastern colonies regularly call, and that the distance from Perth, the capital of Western Australia, and from King George's Sound, to Adelaide, the capital of South Australia, is 1,670 miles in the former case, and 1,220 miles in the latter, the usual length of passage from King George's Sound being four days. It therefore results that convicts do escape by sea from Western Australia, some of whom have been captured and dealt with in the eastern colonies. The population of Western Australia being 16,000, of whom but 11,500 are non-convict, and the whole population of the Colonies of Australia being about 1,317,000, expirees do, and will, as a general rule leave a country where their history is known; where employment is limited and wages are low; and where the field for enterprise and new occupation is confined within narrow limits and uncertain in its view, and pass to others where the population is large and the opportunities of gain considerable. After alleging other arguments against the proposed measure, the colonists conclude by saying that they use no language of menace, but rely on the justice of the people of this country. They declare that their well-grounded anxieties on this question cannot, and will not subside, unless transportation to any part of Australasia be abolished at once and for ever. The document is signed by Sir Francis Murphy, Speaker of the Legislative Assembly, Chairman of the Committee, and many others.

## Obituary.

JOHN WATKINS BRETT was born in Bristol, in the year 1805, and was the son of a tradesman of that city. He very early manifested a taste for the fine arts. This strong bias of his mind induced his parents to put him under the tuition of an artist of Bristol, of the name of Mintorn. Here he remained from about his twelfth to the close of his twenty-first year, studying as an artist. Some years before he was of age his services were much in request as a tutor in drawing and water-colour painting. In the year 1830 he took a house at Clifton, with the purpose of pursuing his profession. He more especially excelled, at this period, in miniature painting on ivory, but his taste and aims in art were universal. It was about this time that he paid a visit to some of the most celebrated galleries of the Continent, where he eagerly studied the celebrated works of the old masters, bringing back with him many memorial sketches of what he saw. There was at this time every promise of his taking a foremost place among the artists of his country; but this was destined not to be fulfilled, for on a night in the year 1831, a few days before the notorious Bristol riots, a fire took place, by which his own studies, accumulated for many years, and some rare works of art besides, perished in the flames. This formed a turning point in his life, and drew him from the practical pursuit of his profession to the study and collection of works of the old masters; and he shortly after left for the United States of America with a considerable quantity of fine paintings. There he remained for a few years, and soon after his return took up his abode in Hanover-square, where he resided for about twenty-eight years, devoting his attention to works of the old masters, and to works of art of every kind. When the electric telegraph was first started, his attention was powerfully attracted to the subject, and he seems early to have cultivated the idea of the possibility of extending it beyond the land, and making it an agent of almost instantaneous communication with all parts of the globe. In his work on the "Origin and Progress of the Oceanic Electric Telegraph," he says:—"My first idea of submarine telegraphs arose out of a conversation with my brother Jacob, early in 1845, when discussing the system of electric telegraphs as then recently established between London and Slough; and in considering the practicability of an entire underground communication, the question arose between us, 'If possible under ground, why not under water? and if under water, why not along the bed of the ocean?' The possibility of a submarine telegraph line then seized upon my mind, with a positive conviction, which led to the consideration of a plan for an entire new principle of subterranean and oceanic electric telegraphs. My brother being possessed of great natural mechanical talents, also at once occupied himself with the embryo model for a printing telegraph, to work by a single wire. Having completed our plans, my brother registered a company (June, 1845), for uniting America with Europe, by the very route since carried out, but at that time failed to obtain the attention of the public, it being considered too hazardous for their support. Having failed in July, 1845, in our offers to the English Government to unite Dublin Castle with Downing-street, I applied in 1846 to the French Government for a privilege to lay a submarine cable between Dover and Calais, which was accorded by Louis Philippe, and subsequently renewed by the Emperor of the French, and the present cable between Dover and Calais was laid on the 25th September, 1851, but an experimental line had been submerged the previous year, by which I passed the first electric message ever sent from one continent to another, which was printed by the instrument in Roman type. In 1847 I applied for a concession to the King of the Belgians, and, finally, in 1852, obtained this privilege, under which the second cable to the Continent was successfully laid on the 6th May, 1853, from Dover to Ostend. On the 19th July, 1852, the Act for the European and American Telegraph Railway was obtained at my cost, and I laid down, by virtue of this Act, the underground lines from Dover to London, Birmingham, Manchester, and Liverpool. The great objects I continually had in view were the submarine lines eastward to India and westward to America. In June, 1853, I obtained the concessions from the French and Sardinian Governments for the Mediterranean, as part of the Indian line. In January, 1855, I entered into an engagement with the New York, Newfoundland, and London Telegraph to establish the Atlantic line, and Mr. Cyrus W. Field having united with me to carry out this enterprise, the present Atlantic Company was formed in 1856 for that purpose." Mr. Brett was never married, and died on the 3rd December, 1863, at the age of 58. He was elected a member of the Society of Arts in 1861.

In the notice of the late JAMES TULLOCH, F.R.S., in the *Journal* of the 8th inst., an error inadvertently occurred. The Directors of the Guardian Assurance Company did not present the vases to him and his brother in 1856 but in 1821.

## Publications Issued.

### ILLUSTRATED BOOKS.

The art of illustration, as applied to poetical and other works, shows marked progress, and there appears to be increased appreciation of superior engravings or other means of illustration.

The Ingoldsby Legends are made more attractive by the drawings of Cruikshank, Tenniel, and Leech. The illustrated edition of this work, published by *Richard Bentley*, is embellished with engravings by the three artists already named. The engravings, sixty in number, are produced by Dalziel; twenty-four are by Cruikshank, thirty by Tenniel, and six by Leech.

The English Lakes, Mountains, and Waterfalls, poems by Wordsworth, published by *A. W. Bennett*, is a work photographically illustrated by Mr. T. Ogle.

The Old English Ballads, published by *Ward and Lock*, is illustrated by Birket Foster, John Gilbert, Joseph Nash, Frederick Tayler, George Thomas, John Absolon, and John Franklin. Drawings of princely knights, of Robin Hood, of jolly abbots and merry kings, of fair ladies and joyous sports, are the worthy subjects of these artists.

The Parables, illustrated by Millais, is engraved by the Brothers Dalziel. (*Routledge.*) Each parable is made the subject of an engraving. Cleverness of interpretation and execution, coupled with excellence of design, are among the merits of this book.

A Chronicle of England, between B.C. 55 and A.D. 1485, is written and illustrated by James E. Doyle. (*Longman.*) The designs, engraved and printed in colours by Edmund Evans, express with clearness the action of the various scenes described, whilst a careful consideration of costume and architecture is made evident.

The Life and Adventures of Robinson Crusoe, illustrated by T. D. Watson, with 100 engravings by the Brothers Dalziel (*Routledge.*) This book excites curiosity from the fact of its having been so often illustrated before by others. Mr. Watson was the successful illustrator of an edition of "The Pilgrim's Progress."

## Forthcoming Publications.

A Life of William Makepeace Thackeray, containing, it is said, much original and interesting matter relative to the early career of this great humourist, will shortly be published by *Mr. Hatton*, of Piccadilly. The author, Mr. T. T. Taylor, long resident in Paris, has been collecting information for many years, and will have much to say of Mr. Thackeray's artist life in that city. The book will be illustrated with some curious original sketches, and a portrait said to be original.

## Notes.

The Royal Horticultural Society has announced that it will hold an exhibition of ancient and modern bouquet-holders, to be opened on the 13th July, and to continue open for four weeks. For the three most artistic and effective modern bouquet-holders, made since July, 1861 (the opening of the Gardens), they will award three medals—one gold, one silver, and one bronze. The ornamentation of these bouquet-holders may be with precious stones or their imitations, enamelling of all kinds, niello work, or any other process. The competition is open to all nations.

Submarine Telegraphs.—A submarine cable has just been manufactured by Messrs. Siemens and Halske, at their cable works, Woolwich, for the French Government. The cable is for the purpose of connecting Carthagena, in Spain, with Oran, in Algeira, and is 115 nautical miles long. The conductor consists of a strand of three annealed copper wires of the best conductivity, each ·038 of an inch in diameter, and weighing together 72lbs. per nautical mile. The resistance of the strand is measured by 18·5 Siemens's mercury units, at a temperature of 20° C. The insulating covering consists of three alternate coatings of Chatterton's compound and the best gutta-percha, bringing the diameter of the core to ·26 of an inch. The weight of the insulating material is 144lbs. per nautical mile. The resistance of the insulating medium varies from 125 to 175 millions of Siemens's units at a temperature of 24° C. without pressure, and from 300 to 400 millions under a pressure equal to 1,400 fathoms of water. The outer covering is composed of two layers of the best hemp strings, dipped in a solution of sulphate of copper, and weighs 200lbs. per knot. It has been laid on under tension, and is encased in a flexible copper sheathing formed of four strips of phosphuretted best copper overlapping each other. The complete cable weighs 7½ cwts. per knot, and its breaking weight is 26cwt. Its specific weight is 1·9, and its diameter ·046 of an inch, and its length is 137 knots, as shipped on board the French Government vessel on the 15th of December, and when tested there gave the following results:—Resistance of conductor, 18·2 Siemens's units per knot; of insulating medium, 1,300 units per knot at a temperature of 13° C. This cable is now being laid by the contractors, Messrs. Siemens and Halske.

## Correspondence.

Trade Marks.—Sir,—Seeing that this subject is mentioned in this week's *Journal*, I beg to say that as far back as 1851 this question was supposed to have been settled. At a meeting held at the Crystal Palace permission was (as I understood) obtained to use the Exhibition seal, with the monogram or initial of each exhibitor at the bottom. This seal would have distinguished each exhibitor for ever; how it happened that this arrangement was not carried out I am unable to tell. Pads and stamps were to have been used similar to those of the Post-office, but it seemed a difficult task to get those articles properly made. Can any member give me information? I am, &c., Henry Nicholls.

63, Jermyn-street, St. James's, Jan. 17, 1863.

Subways.—Sir,—It is not often that original inventors and projectors are so completely lost sight of when their projects or inventions happen, as in this case, to be fully carried out. Mr. John Williams, formerly a stationer and bookbinder in Cornhill, and the patentee of the flat-opening ledgers, was the original projector of "subways" under the streets of London. Some years previous to 1822 that gentleman had taken out a patent with that object, and in that year I afforded him some assistance in making out the plans and sections of his proposed subways, intended to be placed over the sewers, and to contain all the gas and water pipes in such a manner as that they should be always accessible throughout their whole length without it being necessary to tear up and relay the carriage way of the London streets. Mr. Williams spared no expense, and devoted himself to his project for a long series of years. He put himself in communication with every member of Parliament, and with every influential gentleman of the day, He called public meetings, at one of which the well-known De Berenger, of Stock Exchange notoriety, was present. The result was that his scheme was summarily put down by all classes, engineers included, and voted impracticable; but if carried out notwithstanding, that it would form a refuge for a lawless mob, that might break out some dark night, and reduce the whole of London to ashes. For the last forty years the metropolitan streets have, for one purpose or another, been in a continual state of tearing up and laying down at an enormous expense to companies, commissioners, and the public at large, which would have covered the first cost of Mr. Williams's subways ten times over. In the years 1844-45 he was, to my knowledge, still actively engaged in fruitlessly following up his favourite project, but since that time, when he lived at Blackheath, I have entirely lost sight of him, and suppose that he must be dead. The subway now completed in the new street over the water is due to Mr. Williams, and not to the Thames Tunnel, constructed by the late eminent civil engineer, Sir Isambard Brunel.—I am, &c., HENRY W. REVELEY.

Reading.

## MEETINGS FOR THE ENSUING WEEK.

MON. ...R. Geographical, 8½. 1. *a.* "Mr. Hector's Exploring Expedition in Middle Island, New Zealand;" *b.* "Report of Mr. McKerrow on the Lake District of Otago." 2. "Lefroy's Expedition in Western Australia," communicated by the Colonial Office. 3. Professor H. Y. Hind, "Ascent of the Moisie River, Labrador."
Entomological, 7. Annual Meeting.
Actuaries, 7.
Medical, 8½. Mr. Walter J. Coulson, "On Lithotrity."

TUES. ...Med. and Chirurgical, 8½. 1. Dr. Habershon, "On the Effects of Implication of the Pneumogastric Nerve in Aneurismal Tumours" (conclusion). 2. Dr. John Harley, "On the Endemic Hæmaturia of the Cape of Good Hope." 3. Mr. Callender's Account of Amputations, at St. Bartholomew's Hospital, 1853-63."
Royal Inst., 3. Prof. Tyndall, "On Experimental Optics."
Civil Engineers, 8. Mr. J. B. Redman, "The East Coast, between the Thames and the Wash Estuaries."
Zoological, 9.
Ethnological, 8. 1. Mr. Alfred R. Wallace, "On the Ethnology of the Indian Archipelago." 2. Mr. S. Casie Chitty Maniegar, "An Account of the Mookwas, in the District of Putlam, in Ceylon."

WED. ...Society of Arts, 8. Mr. Samuel Brown, "On the Metric System of Weights and Measures, and its Proposed Adoption in this Country."
Archæological Assoc., 8½. 1. Mr. Planché, "On a Stone Coffin and Cross, discovered at Ash." 2. Mr. Vere Irving, "On the Discovery of Roman Remains at Carlisle."

THUR. ...Royal, 8½.
Antiquaries, 8.
Philosophical Club, 6.
Artists and Amateurs, 8.
Royal Inst., 3. Prof. Tyndall, "On Experimental Optics."

FRI.......Royal Inst., 8. Prof. Frankland, "On the Glacial Epoch."

SAT. ...Royal Inst., 3. Mr. J. Lubbock, "On the Antiquity of Man."

## Patents.

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*From Commissioners of Patents Journal, January* 15*th.*

### GRANTS OF PROVISIONAL PROTECTION.

Aerial locomotion—3284—H. R. de Saint Martin.
Aniline colours—3302—G. Phillips.
Artificial manure—3264—J. Maynes.
Atmospheric railways—35—W. Malins.
Brushes—45—E. G. Camp.
Coffer dams—47—C. J. Appleby and J. Vavasseur.
Cotton gins—3286—H. Bayley.
Cotton spinning—39—R. A. Brooman.
Fabrics, ornamental—3305—R. Bell.
Felted fabrics—29—J. H. Whitehead.
Furniture padding, rendering obnoxious to vermin—3097—J. Tod.
Heating apparatus—3294—J. M. Vanderfeesten.
Holdfasts for securing the ends of bands—3244—R. E. V. Hecs.
Hydro-carbons, &c.—3296—T. B. Cochrane.
Igniting explosive projectiles—3258—A. Noble.
Kilns for drying bricks, &c.—3266—J. Duckett.
Kneading machine—3262—W. E. Gedge.
Knives for rag cutting engines—3238—W. E. Gedge.
Lathes—3254—S. B. Ardrey, S. Beckett, and W. Smith.
Lifts for raising or lowering weights—3240—J. Gjers.
Locomotive engines—3260—W. Marsden and F. H. Stubbs.
Looms—9—J. and R. Blakey.
Lubricating composition—3290—H. Caunter.
Metallic surfaces, uniting—27—W. B. Barnard.
Oakum, &c., converting rope into—3246—J. Ronald.
Paper cop tubes—13—W. Ambler.
Percussion fuzes—3250—W. Clark.
Pistons, packing—3148—P. Ward.
Potash, caustic—3232—J. Shanks.
Projectiles for ordnance—3268—J. D. Bryant.
Projectiles—3270—D. S. Price.
Pumps—3288—J. Price.
Purses, &c.—3280—W. Clark.
Railway bridges—3085—R. Thornton.
Railways, permanent way of—3276—J. E. Billups.
Reaping and mowing machines—3054—R. Hornsby, jun., and J. E. Phillips.
Saccharine substances, centrifugal machines for treating—2342—P. A. L. de Fontainemoreau.
Sewing machines—3292—J. Cumming.
Sewing machines—11—H. A. Bonneville.
Shields or tips for boots and shoes—3242—J. H. Johnson.
Shields or tips for boots and shoes—3256—J. H. Johnson.
Ships' masts—43—J. B. Elwell.
Ships of war—3281—T. Tozer.
Sizing yarns—19—J. Bullough.
Sizing yarns—3225—J. Eastwood.
Slide valves—3279—W. Clark.
Steam boilers, feeding—3236—R. A. Brooman.
Steam boilers—3274—T. Hall.
Steam boilers, removing the scum from the interior—3248—J. Knowles.
Stoves, &c., decorating—3278—W. Wilson.
Teasling machine—3298—W. E. Gedge.
Telegraphic cables—3252—F. Walton.
Theatrical purposes, exhibiting the flow of real water for—3272—E. T. Smith.
Toys—3300—A. C. J. Lengelée, F. P. Morel, and D. G. M. Coquet.
Turnip cutter—3234—J. Sainty.
Watches, securing—15—F. Andoe.
Water gauges—49—J. Bond.
Windlasses—3282—J. B. Cronin.
Wool carding—37—E. Fairburn.

### INVENTION WITH COMPLETE SPECIFICATION FILED.

Knitting machinery—34—G. T. Bousfield.

### PATENTS SEALED.

1809. F. A. Calvert.
1810. R. B. Brassey and J. Hargreaves.
1812. J. B. and W. H. Bailey.
1813. A. Smith.
1816. F. Ayckbourn.
1821. C. H. Roeckner.
1827. G. Haseltine.
1831. W. E. Newton.
1843. M. A. Soul.
2056. C. G. Wilson.
2648. J. Marshall.

*From Commissioners of Patents Journal, January* 19*th.*

### PATENTS SEALED.

1823. W. L. Aberdein.
1824. C. S. Duncan.
1829. G. Alcan.
1830. W. Naylor.
1834. C. Senior.
1840. W. Cole.
1845. W. and J. Garforth.
1852. A. English.
1857. P. E. Gay.
1858. J. Boyd.
1859. F. Tolhausen.
1863. F. and L. Ford.
1864. T. Thorne.
1865. G. Haseltine.
1874. J. Jewell.
1889. G. Smith, jun.
1909. E. Sutton.
1910. T. Fellowes & H. Hemfrey.
1913. J. W. P. Field.
1924. E. A. Cotelle.
1942. W. Clark.
1951. A. V. Newton.
1984. W. Gray.
2033. E. H. Bentall.
2045. J. Arthur.
2126. E. Amourous.
2201. A. V. Newton.
2287. P. McLaurin.
2331. T. B. Daft.
2745. S. Smith.
2859. J. Southgate.
2958. W. E. Newton.

### PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

121. E. Stevens.
87. M. A. Muir & J. McIlwham.
122. H. Sagar.
104. J. Horsey.
125. J. Reading.
130. W. Spence.
163. R. Mushet.
129. R. W. Swinburne.
169. G. White.
124. E. Whittaker and J. Clare.

### PATENTS ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

157. E. Clark.
159. E. Clark.
130. M. A. Muir & J. McIlwham.
148. R. and J. Reeves.
185. H. Cater.
291. W. E. Newton.
258. G. E. Dering.
153. T. Sagar and C. Turner.

## Registered Designs.

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Spring holder for gas and lamp glasses and shades—4612—Jan. 5—D. Hulett, High Holborn.
Continuous stave board for pails, tubs, and vats—4613—Jan. 7—J. B. Palmer, Upper Thames-street.
A water syringe end—4614—Jan. 18—Thos. Hickin, Birmingham.